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(71)Applicant : NATIONAL INSTITUTE OF ADVANCED INDUSTRIAL & TECHNOLOGY
KIYOMIYA KOICHI

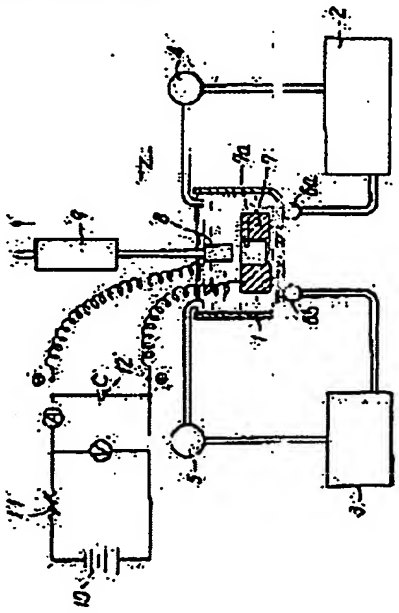
(72)Inventor : KIYOMIYA KOICHI

(54) ELECTROLYTE FINISHING METHOD FOR ELECTRIC DISCHARGING SURFACE

(57)Abstract:

PROBLEM TO BE SOLVED: To provide an electrolyte finishing method for an electric discharging surface where an arrangement is miniaturized and a production cost is reduced by executing an electrical discharge machining and an electrochemical machining in the same device, and a high-precision positioning between an electrode tool and the electric discharging surface is enabled in polishing, and an improvement of workability is devised.

SOLUTION: In a vessel 1 filled with an electric discharge solution,a workpiece 7 is opposed at a specific interval to an electrode tool 8, which is movable toward Z axis which is orthogonal to both X, Y axis and is fixed for X, Y axis which are mutually orthogonal in a horizontal plane, and by making the workpiece 7 a positive electrode, and making the electrode tool 8 a negative electrode, a voltage is impressed between the electrodes. After having processed the workpiece 7 conform to the electrode form, the electric discharge solution in the vessel 1 is counterchanged with electrolytic solution, and a constant electrolytic current is passed between the electrode tool 8 and the workpiece 7, and an electrochemical machining surfaces 7a is abrasively finished.



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(71)出願人　301021533
独立行政法人産業技術総合研究所
東京都千代田区霞が関１－３－１
(71)出願人　599129982
清宮　紘一
千葉県我孫子市つくし野７－19－12
(72)発明者　清　宮　紘　一
茨城県つくば市並木１丁目２番地　経済産業省産業技術総合研究所機械技術研究所内

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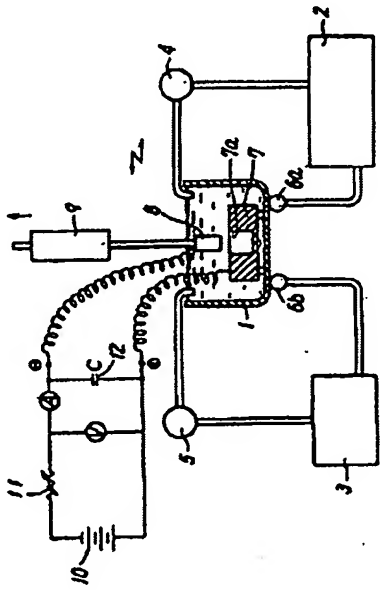
(54)【発明の名称】　放電加工面の電解仕上げ方法

(57)【要約】
【課題】 放電加工と電解研磨を同じ装置内で行なうことで、設備を小型コンパクト化し、生産コストを低減し、電解研磨時の電極工具と放電加工面との位置決めを高精度に可能とし、作業性の向上を図ることができる放電加工面の電解仕上げ方法を提供する。
【解決手段】 放電加工液が注入された容器１内に、水平面内に互いに直交するＸ，Ｙ軸方向に固定でＸ，Ｙ軸の両者に直交するＺ軸方向に移動可能な電極工具８に対して所定間隔をおいてワーク７を対向させ、ワーク７を陽極とし、電極工具８を陰極として両極間に電圧を印加し、放電によってワーク７に電極形状に応じた加工を施した後、容器１内の放電加工液を電解液に入れ替え、電極工具８とワーク７の間に一定の電解電流を流し、ワーク７の放電加工面７ａを電解によって研磨仕上げしてなる。



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【特許請求の範囲】

【請求項１】放電加工液が注入された容器内に、水平面内において互いに直交するＸ，Ｙ軸方向に固定で上記Ｘ，Ｙ軸の両者に直交するＺ軸方向に移動可能な電極工具に対して、所定間隔をおいてワークを対向させ、上記ワークを陽極とし、上記電極工具を陰極として両極間に電圧を印加し、放電によって上記ワークに電極形状に応じた加工を施した後、上記容器内の放電加工液を電解液に入れ替え、上記電極工具と上記ワークの間に一定の電解電流を流し、上記ワークの放電加工面を電解によって研磨仕上げすることを特徴とする放電加工面の電解仕上げ方法。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、放電加工時に加工面に生じる変質層を電解により除去し研磨仕上げするための放電加工面の電解仕上げ方法に関する。

【０００２】

【従来の技術】一般に、放電加工装置では、容器に注入された白灯油や水などの加工液中に、金属加工品であるワークを固定し、陽極となるワークの加工面に対して、微小な間隙を有するように陰極の電極工具を対向させ、当該間隙中で放電を行ない、ワークを放電加工するものであるが、放電加工のままでは、ワークの放電加工面に硬くて厚い変質層ができる。そこで、放電加工後、電解による仕上げ研磨工程を設け、ワークの放電加工面を電解仕上げする方法が、たとえば、「電気加工学会誌　Vol.22,No.43,P.18～28　酒井・増沢共著」に提案されている。この電解仕上げ方法は、放電加工によりワークを加工した後、ワークを陽極電極とし、ワークに対向する陰極電極を設けて、ワークの放電加工面と陰極電極とを均等な間隙を有するように静止状態に保持し、当該間隙に電圧を印加することにより、ワークの放電加工面を電解仕上げするものである。

【０００３】

【発明が解決しようとする課題】しかしながら、従来例においては、放電加工と電解仕上げとが別々の装置で個別に行われており、従って、ワークの加工に際しては、放電加工装置および電解研磨装置をそれぞれ用意しなければならないため、設備が大型化し、多大の設備投資が必要になり、生産コストが高くなるという問題点がある。また、電解仕上げする際に電極工具をワークの放電加工面に位置決め設置する必要があり、このとき、電極工具と放電加工面との位置ずれが生じ、充分な位置決め精度の確保が困難であると共に、作業性が著しく低下するという問題点がある。

【０００４】本発明は、上記のような問題点に鑑みてなされたものであって、その目的とするところは、放電加工と電解研磨を同じ装置内で行なうことで、設備を小型コンパクト化し、生産コストを低減し、電解研磨時の電極工具と放電加工面との位置決めを高精度に可能とし、作業性の向上を図ることができる放電加工面の電解仕上げ方法を提供することにある。本発明の上記ならびにその他の目的と新規な特徴は、本明細書の記述および添付図面から明らかになるであろう。

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【０００５】

【課題を解決するための手段】上記目的を達成すべく、本発明に係る放電加工面の電解仕上げ方法は、放電加工液が注入された容器内に、水平面内において互いに直交するＸ，Ｙ軸方向に固定で上記Ｘ，Ｙ軸の両者に直交するＺ軸方向に移動可能な電極工具に対して、所定間隔をおいてワークを対向させ、上記ワークを陽極とし、上記電極工具を陰極として両極間に電圧を印加し、放電によって上記ワークに電極形状に応じた加工を施した後、上記容器内の放電加工液を電解液に入れ替え、上記電極工具と上記ワークの間に一定の電解電流を流し、上記ワークの放電加工面を電解によって研磨仕上げすることを特徴としている。

【０００６】従って、本発明では、放電加工が行われた容器内の放電加工液を電解液に入れ替え、Ｚ軸方向にのみ移動可能な電極工具とワークの放電加工面との間に一定の電解電流を流し、ワークの放電加工面が電解によって研磨仕上げされるので、ワークの放電加工と電解研磨とが１つの装置内で行われる。また、電極工具とワークの放電加工面との位置関係がそのまま電解研磨に流用されるので、電極工具とワークの放電加工面との位置決めが簡便かつ確実になり、電極工具と放電加工面との充分な位置決め精度が確保され、作業性が向上する。

【０００７】

【発明の実施の形態】以下、本発明の一実施の形態を図１および図２に基づいて詳細に説明する。実施の形態を説明するに当たって、同一機能を奏するものは同じ符号を付して説明する。図１は、放電加工面の電解仕上げ方法に使用する装置例を示すもので、この装置において、容器１の開口部には、水や白灯油などの放電加工液が貯留された加工液貯留タンク２、硝酸ソーダなどの電解液が貯留された電解液貯留タンク３が、ポンプ４，５を個別に介して連通されており、容器１の底部には、切換弁６ａ，６ｂをそれぞれ介して加工液貯留タンク２および電解液貯留タンク３が個別に連通され、放電加工液および電解液が容器１に供給されると共に、加工液貯留タンク２および電解液貯留タンク３に回収されるようになっている。

【０００８】また、容器１内には、金属加工品であるワーク７が固定され、このワーク７の上方には、電極工具８が送り機構９によって上下方向にのみ（Ｘ，Ｙ軸方向に固定でＺ軸方向に移動可能）移動可能に設置されている。ワーク７は直流電源１０の陽極に接続され、電極工具８は直流電源１０の陰極に可変抵抗器１１を介して接続され、ワーク７と電極工具８との間には、コンデンサ

１２が接続されている。なお、図示はしていないが、放電加工および電解研磨は、それぞれ別々の電源を用いるものとする。

【０００９】本実施の形態の放電加工面の電解仕上げ方法は、図１に示す装置を用いて、まず、切換弁６ａ，６ｂの流路を閉じた状態で、ワーク７を固定した容器１内に、ポンプ４によって加工液貯留タンク２内の放電加工液を注入した後、電極工具８をワーク７の被加工部に対して所定間隔をおいて対向させる。次に、ワーク７を陽極とし、電極工具８を陰極として、両極間に電圧を印加し、電極工具８を上下に繰り返し移動させながら、放電によってワーク７の被加工部を溶融・蒸発させることで、電極工具８の形状に応じた放電加工面７ａが形成される。この場合、電極工具８を数段階に分けて適宜形状のものと交換し、放電加工することで、所望形状の放電加工面７ａが得られる。

【００１０】その後、電極工具８を引き上げ、放電加工面７ａより離した状態で、切換弁６ａの流路を開き、容器１内の放電加工液を加工液貯留タンク２に回収する。そして、切換弁６ａの流路を閉じた状態で、電解液貯留タンク３内の電解液をポンプ５によって容器１内に注入する。

【００１１】次に、放電加工において最終的に使用した電極工具８を下降し、放電加工時と同じ微小間隙をおいて放電加工面７ａに対向させ、電極工具８とワーク７の両極間に電圧を印加すると、両極間の抵抗に逆比例した一定の電流が流れ、放電加工面７ａに生じた変質層が電解によって電解液中に溶出し、放電加工面７ａは仕上げ研磨される。

【００１２】ところで、図２は、上記の電解仕上げ方法において、パルス波を与えながら放電加工面７ａを溶出させるパルス電解を採用した場合の、電流オン・オフタイム別の加工時間に対する電極間の最終電流値の変化を示す特性図であるが、電流オンタイムが長いもの程、加工時間に伴って電流値が低下していくのが分かる。これは、電流オンタイムが長くなれば、放電加工面７ａの付近に金属イオンが電解液中に溶出し拡散した陽極液層が高濃度に存在し、電解によって生じたガスが電極工具８の表面に多く付着し、これら陽極液層やガスが電気の流れを妨げているからである。

【００１３】そこで、本実施の形態では、電極工具８を上下動させ、放電加工面７ａに対する接近・離反動作を繰り返し行なうことで、放電加工面７ａと電極工具８間の電解液の流動性をよくして、陽極液層を両極間より外部に流動させるようにすると共に、電極工具８を引き上げることで、ガス抜きを行なうようにし、電解溶出の安定化を図るようにしている。しかしながら、他の手段によって電解液の流動性を高めることもできる。

【００１４】こうして、電解研磨が終了したら、水洗を実施し、ワーク７に付着した電解液および残留物を除去する。そして、必要があれば、比較的低温の熱処理によって不安定な相を析出させ、硬度および強度を高めることもできる。

【００１５】上記電解研磨において、ワーク７と電極工具８との間隙は、主として放電加工の条件により決まり、即ち、電極工具８を放電加工時と同じ位置に戻して電解研磨するため、最終の放電加工における電極工具８と放電加工面７ａとの間のギャップによって決まり、通常は、０．２～０．３ｍｍになる。なお、場合によっては、放電加工条件により０．１ｍｍ程度になることもあり、電解研磨のために印加される電圧は、ワーク７と電極工具８との間隙の大きさに応じて適切に調整することが必要になる。ワーク７としては、Ｆｅ系、Ａｌ系、Ｃｕ系、Ｎｉ系、Ｔｉ系の金属および合金など、電解研磨可能なものなら特に限定されない。

【００１６】このように、本実施の形態の放電加工面の電解仕上げ方法では、放電加工と電解研磨とを液交換を行なうだけで、同じ容器１内で行なえるので、設備が小型化し、コスト低減が図られ、しかも電解研磨時の電極工具８と放電加工面７ａとの位置決め精度が確保され、作業性を向上することができる。

【００１７】以上、本発明の実施の形態の放電加工面の電解仕上げ方法について詳述したが、本発明は、上記実施の形態記載の放電加工面の電解仕上げ方法に限定されるものではなく、本発明の特許請求の範囲に記載されている発明の精神を逸脱しない範囲で、設計において種々の変更ができるものである。

【００１８】

【発明の効果】以上の説明から理解されるように、本発明の放電加工面の電解仕上げ方法によれば、放電加工が行われた容器内で、放電加工液を電解液に入れ替え、電極工具とワークの放電加工面との位置関係を保持した状態で、放電加工面が電解研磨され、ワークの放電加工と電解研磨とが同じ装置内で行われるので、設備を小型コンパクト化することができ、生産コストの低減化を図ることができ、電解研磨時の電極工具と放電加工面との位置決めを簡便かつ高精度に行なうことができると共に、変質層および亀裂を容易かつむらなく均一に除去することができ、作業性を向上することができる。

【図面の簡単な説明】

【図１】本発明の一実施の形態に係る放電加工面の電解仕上げ方法に使用する装置の概略構成図である。

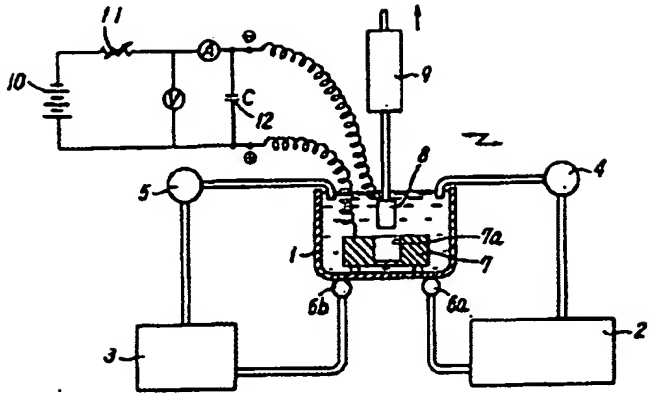
【図２】本発明の一実施の形態に係る放電加工面の電解仕上げ方法において、電流オン・オフタイム別の加工時間に対する電極間の最終電流値の変化を示す特性図である。

【符号の説明】

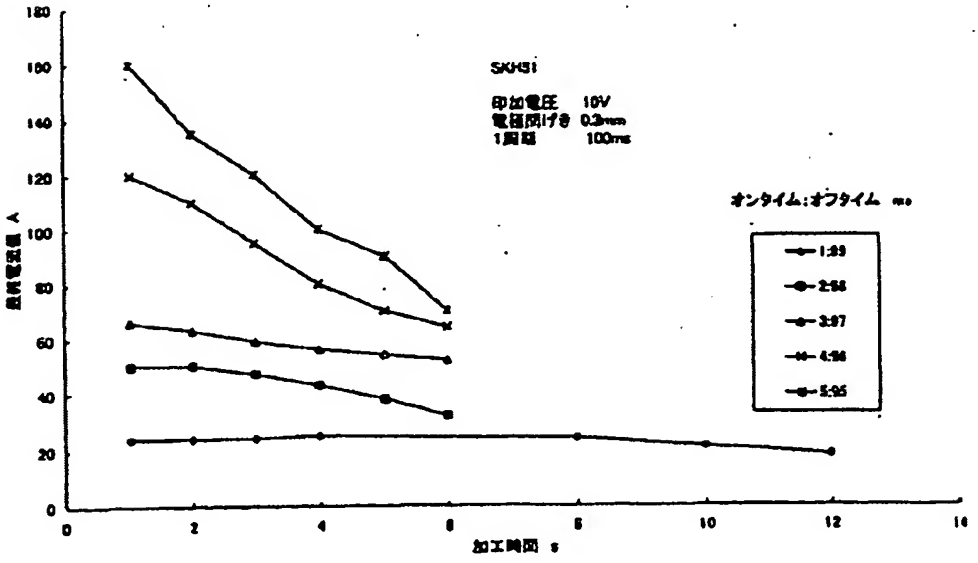
１　容器
２　加工液貯留タンク
３　電解液貯留タンク

4，5　ポンプ
6a，6b　切換弁
7　ワーク
7a　放電加工面
8　電極工具
9　送り機構
10　直流電源
11　可変抵抗器
12　コンデンサ

【図1】



【図2】



CLAIMS

[Claim(s)]

[Claim 1] As opposed to the electrode tool which can move in X which intersects perpendicularly mutually in the level surface in the container with which electrical discharge machining liquid was poured in, and the direction of the Z-axis which intersects perpendicularly with both above X and Y-axis by fixation in the direction of the Y-axis Set a predetermined interval, make a work counter, make the above-mentioned work into an anode, and voltage is impressed among two poles by making the above-mentioned electrode tool into the negative pole. The electrolysis finish method of the electrical discharge machining side characterized by changing the electrical discharge machining liquid in the above-mentioned container to an electrolysis solution, sending fixed electrolytic current between the above-mentioned electrode tool and the above-mentioned work, and carrying out polish finish of the electrical discharge machining side of the above-mentioned work by electrolysis after giving processing to the above-mentioned work according to electrode form by electric discharge.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the electrolysis finish method of the electrical discharge machining side for electrolysis removing the deterioration layer produced in a processing side at the time of electrical discharge machining, and carrying out polish finish.

[0002]

[Description of the Prior Art] As opposed to the processing side of the work which generally fixes the work which is the Metal Processing Division article in working fluid, such as illuminating kerosine poured into the container, and water, with electrical discharge machining equipment, and serves as an anode Although the electrode tool of the negative pole is made to counter so that it may have a minute gap, it discharges all over the gap concerned and the electrical discharge machining of the work is carried out, with electrical discharge machining, a hard and thick deterioration layer is made in the electrical discharge machining side of a work. Then, the method of establishing the finish polish process by electrolysis after electrical discharge machining, and carrying out electrolysis finish of the electrical discharge machining side of a work is "electricity processing

academic journal, for example. It is proposed by Vol.22, No. 43, and 28 Sakai and P.18 - Masuzawa collaboration." This electrolysis finish method uses a work as an anode electrode, after processing a work by electrical discharge machining. Electrolysis finish of the electrical discharge machining side of a work is carried out by preparing the negative pole electrode which counters a work, holding the electrical discharge machining side and negative pole electrode of a work to a state of rest so that it may have an equal gap, and impressing voltage to the gap concerned.

[0003]

[Problem to be solved by the invention] However, in the conventional example, electrical discharge machining and electrolysis finish are individually performed by separate equipment, therefore processing of a work is faced. In order to have to prepare electrical discharge machining equipment and electrolytic polishing equipment, respectively, equipment is enlarged, great plant-and-equipment investment is needed, and there is a problem that a production cost becomes high. Moreover, when carrying out electrolysis finish, it is necessary to carry out positioning installation of the electrode tool in the electrical discharge machining side of a work, the position gap with an electrode tool and an electrical discharge machining side arises at this time, and while reservation of sufficient positioning accuracy is difficult, there is a problem that workability falls remarkably.

[0004] [the place which this invention is made in view of the above problems, and is made into the purpose] It is in offering the electrolysis finish method of an electrical discharge machining side that the small miniaturization of the equipment is carried out, a production cost can be reduced, positioning with the electrode tool at the time of electrolytic polishing and an electrical discharge machining side is enabled with high precision, and improvement in workability can be aimed at by performing electrical discharge machining and electrolytic polishing within the same equipment. The above of this invention, and the other purposes and the new feature will become clear from description and the accompanying drawing of this Description.

[0005]

[Means for solving problem] [that the above-mentioned purpose should be attained / the electrolysis finish method of the electrical discharge machining side concerning this invention] As opposed to the electrode tool which can move in X which intersects perpendicularly mutually in the level surface in the container with which electrical discharge machining liquid was poured in, and the direction of the Z-axis which intersects perpendicularly with both above X and Y-axis by fixation in the direction of the Y-axis Set a predetermined interval, make a work counter, make the above-mentioned work into an anode, and voltage is impressed among two poles by making the above-mentioned electrode tool into the negative pole. After giving processing to the above-mentioned work according to electrode form by electric discharge, the electrical discharge machining liquid in the above-mentioned container is changed to an electrolysis solution, fixed electrolytic current is sent between the above-mentioned electrode tool and the above-mentioned work, and it is characterized by carrying out polish finish of the electrical discharge machining side of the above-mentioned work by electrolysis.

[0006] Therefore, in this invention, the electrical discharge machining liquid in the container with which electrical discharge machining was performed is changed to an electrolysis solution. Since fixed electrolytic current is sent between an electrode tool and the electrical discharge machining side of a work movable only in the direction of the Z-axis and polish finish of the electrical discharge machining side of a work is carried out by electrolysis between, the electrical discharge machining and electrolytic polishing of a work are performed within one piece of equipment. Moreover, since the physical relationship of an electrode tool and the electrical

discharge machining side of a work is diverted to electrolytic polishing as it is, positioning with an electrode tool and the electrical discharge machining side of a work becomes simple and certain, sufficient positioning accuracy of an electrode tool and an electrical discharge machining side is secured, and workability improves.
[0007]
[Mode for carrying out the invention] The form of 1 operation of this invention is hereafter explained in detail based on drawing 1 and drawing 2 . In explaining the form of operation, what does the same function so attaches and explains the same mark. Drawing 1 shows the example of equipment used for the electrolysis finish method of an electrical discharge machining side, and in this equipment [the opening of a container 1] [the electrolysis solution storage tank 3 by which electrolysis solutions with which electrical discharge machining liquid, such as water and illuminating kerosine, was stored, such as the working fluid storage tank 2 and sodium nitrate, were stored] It is open for free passage individually through a pump 4 and 5, and [the bottom of a container 1] It is collected by the working fluid storage tank 2 and the electrolysis solution storage tank 3, while the working fluid storage tank 2 and the electrolysis solution storage tank 3 are individually opened for free passage respectively through a change-over valve 6a and 6b and electrical discharge machining liquid and an electrolysis solution are supplied to a container 1.
[0008] Moreover, in the container 1, the work 7 which is the Metal Processing Division article is fixed, and the electrode tool 8 sends above this work 7, and it is installed by the mechanism 9 possible [movement (movement in the direction of the Z-axis is possible in X and the direction of the Y-axis at fixation) only in the up-and-down direction]. A work 7 is connected to the anode of the direct-current power supply 10, the electrode tool 8 is connected to the negative pole of the direct-current power supply 10 through the variable resister 11, and the capacitor 12 is connected between the work 7 and the electrode tool 8. In addition, although illustration has not been carried out, a respectively separate power supply shall be used for electrical discharge machining and electrolytic polishing.
[0009] [the electrolysis finish method of the electrical discharge machining side of the form this operation] After pouring in the electrical discharge machining liquid in the working fluid storage tank 2 with a pump 4, the electrode tool 8 is made for a predetermined interval to set and counter to the part of a work 7 to be processed in the container 1 which fixed the work 7, where a change-over valve 6a and the channel of 6b are first closed using the equipment shown in drawing 1 . Next, a work 7 is made into an anode, voltage is impressed among two poles by making the electrode tool 8 into the negative pole, and the electrical discharge machining side 7a according to the form of the electrode tool 8 is formed by melting and making it evaporate in the part of a work 7 to be processed of electric discharge, repeating the electrode tool 8 up and down, and moving it. In this case, the electrode tool 8 is divided into several steps, it exchanges for the thing of form suitably, and the request-shaped electrical discharge machining side 7a is acquired by carrying out electrical discharge machining.
[0010] Then, the electrode tool 8 is pulled up, in the state where it detached from the electrical discharge machining side 7a, the channel of a change-over valve 6a is opened, and the electrical discharge machining liquid in a container 1 is collected on the working fluid storage tank 2. And where the channel of a change-over valve 6a is closed, the electrolysis solution in the electrolysis solution storage tank 3 is poured in into a container 1 with a pump 5.
[0011] Next, if descend the electrode tool 8 finally used in electrical discharge machining, and set the same minute gap as the time of electrical discharge machining, the electrical discharge machining side 7a is made to counter and voltage is impressed among the two poles of the electrode tool 8 and a work 7 The fixed current

inversely proportional to resistance between two poles flows, the deterioration layer produced in the electrical discharge machining side 7a is eluted in an electrolysis solution by electrolysis, and the electrical discharge machining side 7a is finished and ground.

[0012] By the way, [drawing 2] although drawing 2 is the characteristic figure showing the change of the inter-electrode last current value to the floor to floor time according to current on-off time at the time of adopting the pulse electrolysis which makes the electrical discharge machining side 7a eluted in the above-mentioned electrolysis finish method, giving a pulse wave The thing which has long current ONTAIMU is understood that a current value falls in connection with floor to floor time. This is because the anode solution layer which the metal ion eluted for which and diffused in the electrolysis solution near the electrical discharge machining side 7a existed in high concentration, a lot of gas on the surface of the electrode tool 8 produced by electrolysis adhered and these anodes solution layer and gas have barred the electric flow, if current ONTAIMU becomes long.

[0013] [then, the thing which the electrode tool 8 is moved up and down and performed by repeating approach / estrangement operation to the electrical discharge machining side 7a with the form of this operation] While receiving the mobility of the electrolysis solution between the electrical discharge machining side 7a and the electrode tool 8 and making it make an anode solution layer flow outside from between two poles, he is made to perform gas omission and is trying to attain stabilization of electrolysis elution by pulling up the electrode tool 8. However, other means can also raise the mobility of an electrolysis solution.

[0014] In this way, if electrolytic polishing is completed, it will wash and the electrolysis solution and residue adhering to a work 7 will be removed. And if there is necessity, comparatively, by low-temperature heat treatment, unstable ** can be deposited and hardness and intensity can also be raised.

[0015] In the above-mentioned electrolytic polishing, [the gap of a work 7 and the electrode tool 8] It is decided mainly by the conditions of electrical discharge machining, namely, in order to return the electrode tool 8 to the same position as the time of electrical discharge machining and to carry out electrolytic polishing, it is decided by the gap between the electrode tool 8 and the electrical discharge machining side 7a in the last electrical discharge machining, and it is usually set to 0.2-0.3mm. In addition, it is necessary to adjust appropriately the voltage impressed for electrolytic polishing according to the size of the gap of a work 7 and the electrode tool 8, since it is set to about 0.1mm according to electrical discharge machining conditions depending on the case. As a work 7, especially if electrolytic polishing is possible for metal, an alloy, etc. of Fe system, aluminum system, Cu system, nickel system, and a Ti system, it is not limited.

[0016] thus, [the electrolysis finish method of the electrical discharge machining side of the form this operation] Since electrical discharge machining and electrolytic polishing can be performed within the same container 1 only by performing liquid exchange, equipment is miniaturized, cost reduction is achieved, moreover the positioning accuracy of the electrode tool 8 at the time of electrolytic polishing and the electrical discharge machining side 7a is secured, and workability can be improved.

[0017] As mentioned above, although the electrolysis finish method of the electrical discharge machining side of the form operation of this invention was explained in full detail This invention is not limited to the electrolysis finish method of the electrical discharge machining side the above-mentioned implementation given in a form, is the range which does not deviate from the soul of invention indicated to the Claims of this invention, and can perform various change in a design.

[0018]

[Effect of the Invention] [according to the electrolysis finish method of the electrical discharge machining side of this invention] within the container with which electrical discharge machining was performed so that I may be understood from the above explanation Where it changed electrical discharge machining liquid to the electrolysis solution and the physical relationship of an electrode tool and the electrical discharge machining side of a work is held Since electrolytic polishing of the electrical discharge machining side is carried out and the electrical discharge machining and electrolytic polishing of a work are performed within the same equipment While being able to carry out the small miniaturization of the equipment, being able to attain reduction-ization of a production cost and being able to perform positioning with the electrode tool at the time of electrolytic polishing, and an electrical discharge machining side simple and with high precision A deterioration layer and a crack can be removed easily and uniformly uniformly, and workability can be improved.

[Translation done.]